Systematic Review Methodology

Abbey Dvorak, Scott McEathron, Amalia Monroe-Gulick, Michael Peper

KU Libraries

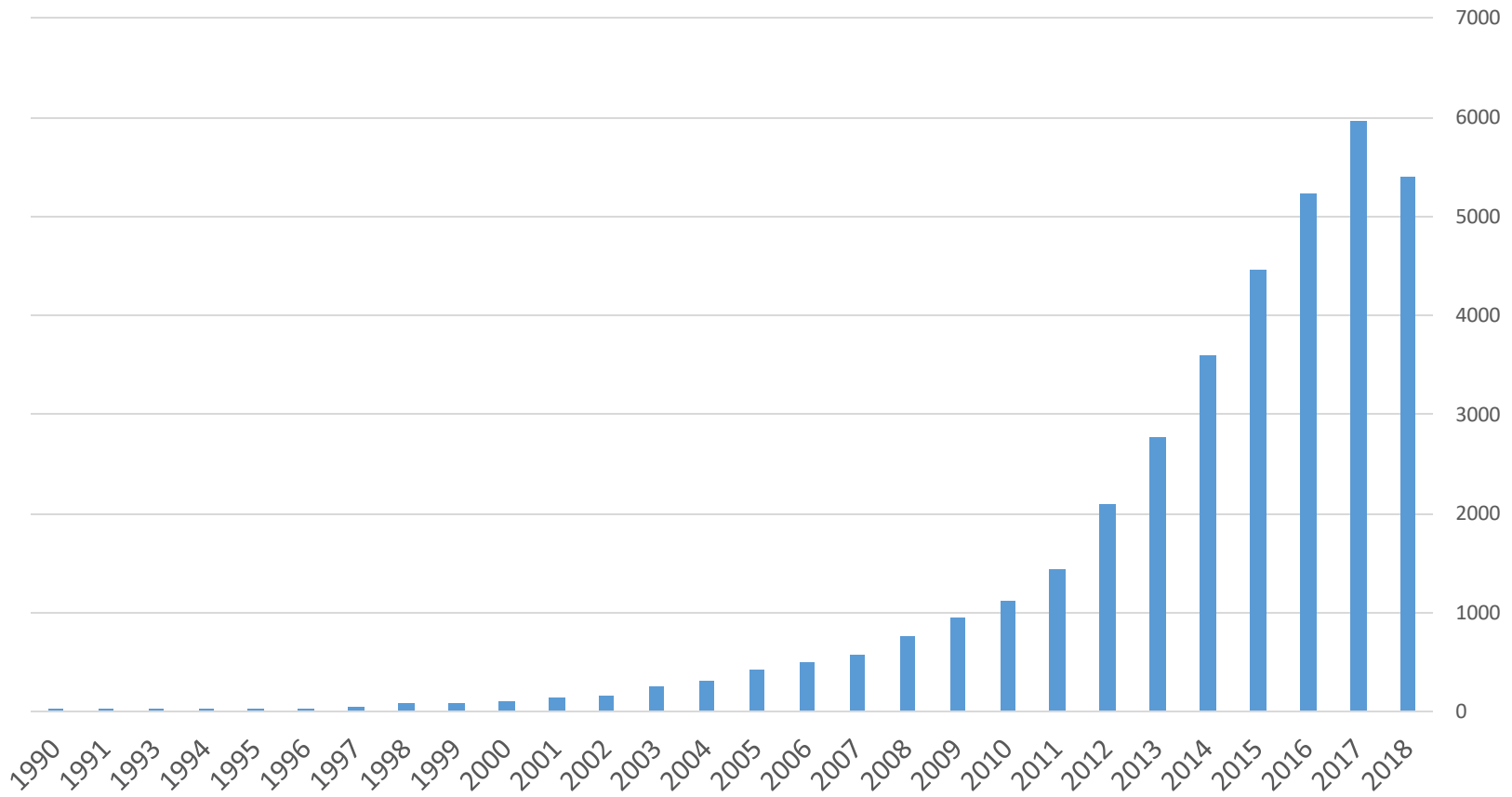
September 13, 2019

Session Outline

- Overview
- Review Types
- Review Research Process
- Question Development (problem formulation)
- Break
- Searching
- Review, Analysis, Manuscript
- Questions and Discussion

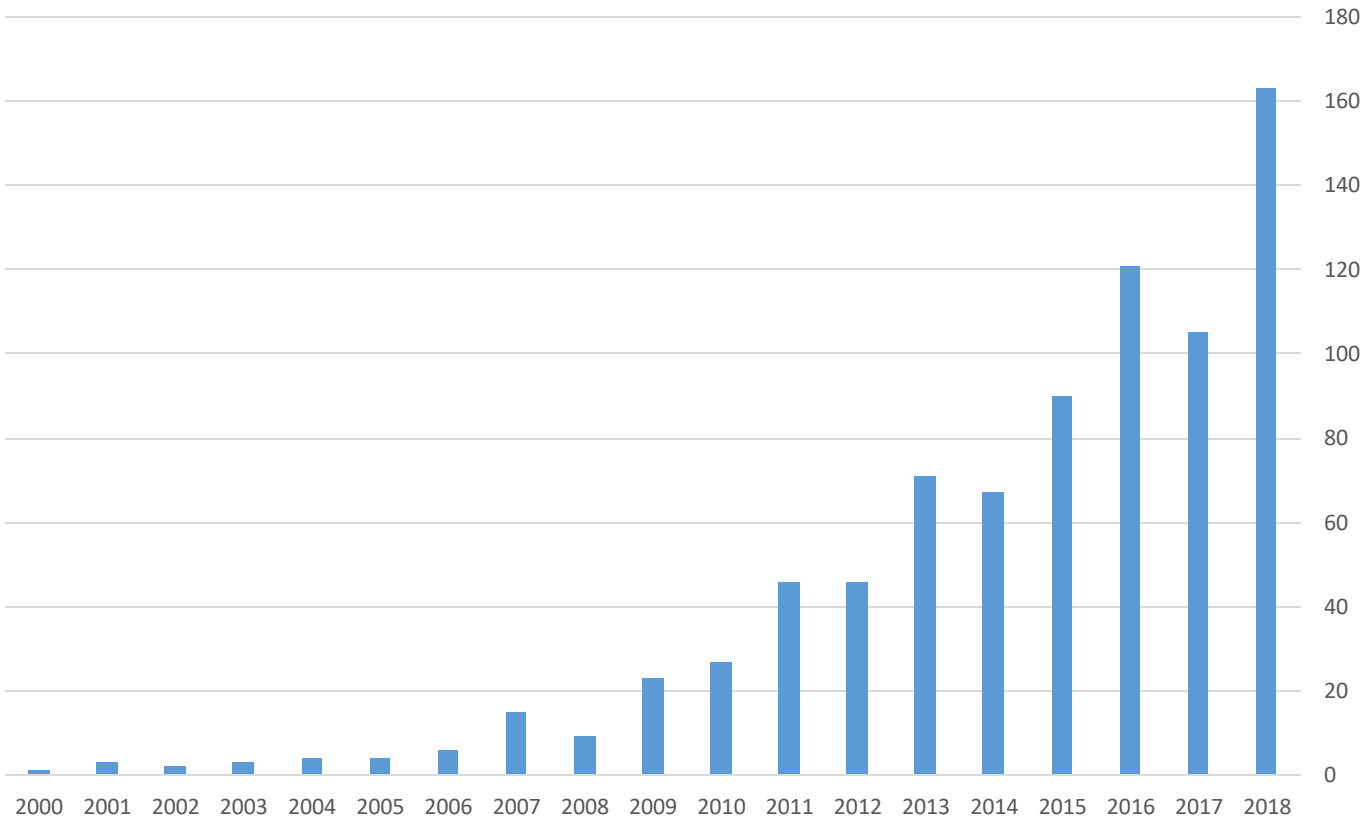
Overview

Growth of Systematic Reviews



PubMed search: ("Meta-Analysis" [Publication Type]) AND "systematic review"[Title/Abstract]

Systematic Reviews in Education



Web of Science: (”systematic review"[Title] in Education categories)

The New York Times

TheUpshot

THE NEW HEALTH CARE

Why Your Doctor's White Coat Can Be a Threat to Your Health

A systematic review of studies found that white coats are frequently contaminated with strains of harmful and sometimes drug-resistant bacteria associated with hospital-acquired infections. As many as 16 percent of white coats tested positive for MRSA, and up to 42 percent for the bacterial class Gram-negative rods.

Cochrane Library

Trusted evidence.
Informed decisions.
Better health.

Cochrane Reviews ▾ Trials ▾ M

PRISMA

TRANSPARENT REPORTING of SYSTEMATIC REVIEWS and META-ANALYSES

Campbell Collaboration

Better evidence for a better world

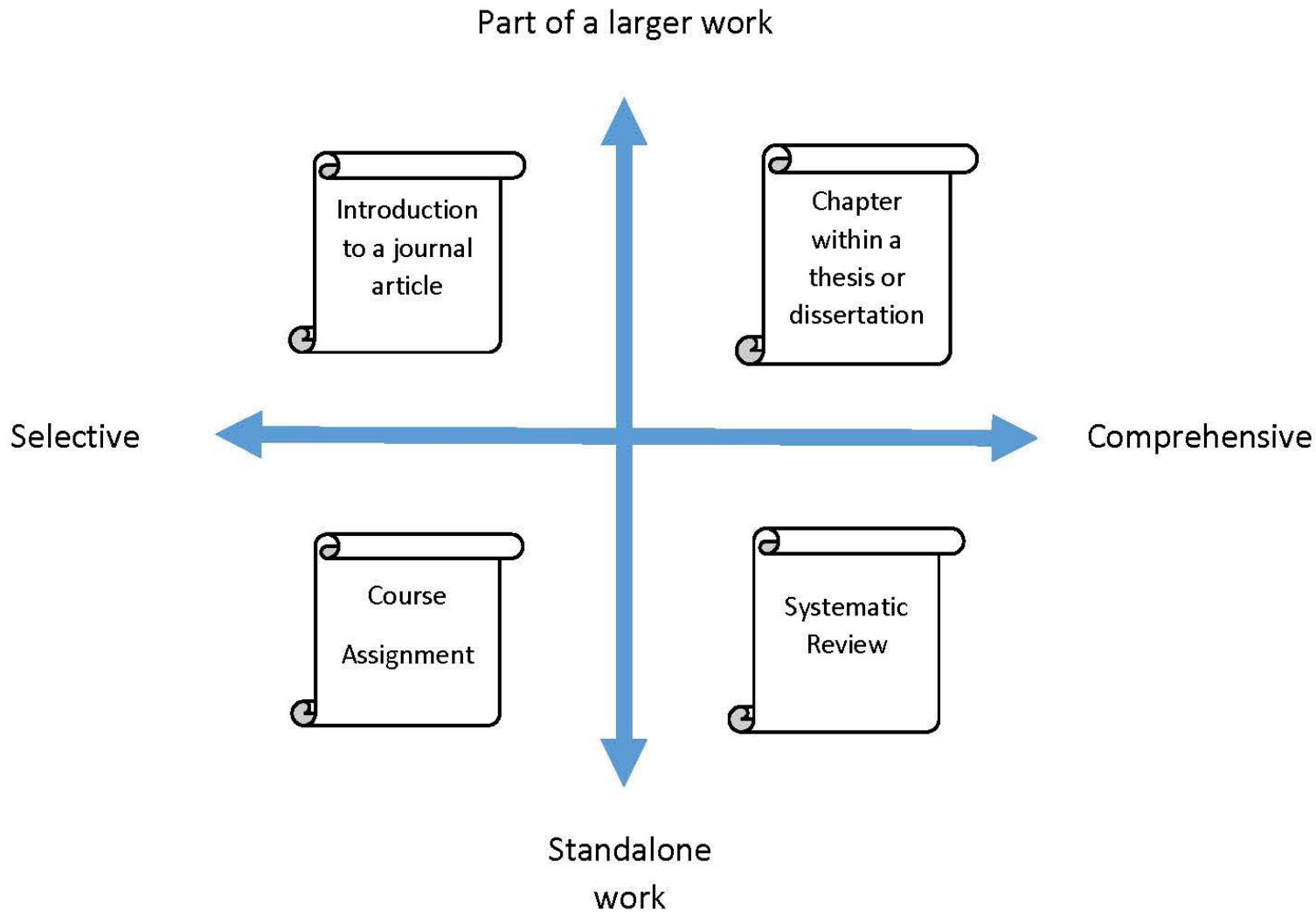
PROSPERO

International prospective register of systematic reviews

Why Systematic Reviews?

- Reduce bias
- Increase sample size
- Combine the power of individual studies
- Aids in decisions about policy, clinical, and research agendas

Review Types



Based on a diagram from: NCSU Libraries, *Literature Reviews: An Overview for Graduate Students,*

https://www.lib.ncsu.edu/tutorials/litreview/

Table 1 Main review types characterized by methods used

		Methods used (SALSA)			
Label	Description	Search	Appraisal	Synthesis	Analysis
Critical review	Aims to demonstrate writer has extensively researched literature and critically evaluated its quality. Goes beyond mere description to include degree of analysis and conceptual innovation. Typically results in hypothesis or model	Seeks to identify most significant items in the field	No formal quality assessment. Attempts to evaluate according to contribution	Typically narrative, perhaps conceptual or chronological	Significant component: seeks to identify conceptual contribution to embody existing or derive new theory
Literature review	Generic term: published materials that provide examination of recent or current literature. Can cover wide range of subjects at various levels of completeness and comprehensiveness. May include research findings	May or may not include comprehensive searching	May or may not include quality assessment	Typically narrative	Analysis may be chronological, conceptual, thematic, etc.
Mapping review/ systematic map	Map out and categorize existing literature from which to commission further reviews and/or primary research by identifying gaps in research literature	Completeness of searching determined by time/scope constraints	No formal quality assessment	May be graphical and tabular	Characterizes quantity and quality of literature, perhaps by study design and other key features. May identify need for primary or secondary research
Meta-analysis	Technique that statistically combines the results of quantitative studies to provide a more precise effect of the results	Aims for exhaustive, comprehensive searching. May use funnel plot to assess completeness	Quality assessment may determine inclusion/ exclusion and/or sensitivity analyses	Graphical and tabular with narrative commentary	Numerical analysis of measures of effect assuming absence of heterogeneity
Mixed studies review/mixed methods review	Refers to any combination of methods where one significant component is a literature review (usually systematic). Within a review context it refers to a combination of review approaches for example combining quantitative with qualitative research or outcome with process studies	Requires either very sensitive search to retrieve all studies or separately conceived quantitative and qualitative strategies	Requires either a generic appraisal instrument or separate appraisal processes with corresponding checklists	Typically both components will be presented as narrative and in tables. May also employ graphical means of integrating quantitative and qualitative studies	Analysis may characterise both literatures and look for correlations between characteristics or use gap analysis to identify aspects absent in one literature but missing in the other
Overview	Generic term: summary of the [medical] literature that attempts to survey the literature and describe its characteristics	May or may not include comprehensive searching (depends whether systematic overview or not)	May or may not include quality assessment (depends whether systematic overview or not)	Synthesis depends on whether systematic or not. Typically narrative but may include tabular features	Analysis may be chronological, conceptual, thematic, etc.
Qualitative systematic review/qualitative evidence synthesis	Method for integrating or comparing the findings from qualitative studies. It looks for 'themes' or 'constructs' that lie in or across individual qualitative studies	May employ selective or purposive sampling	Quality assessment typically used to mediate messages not for inclusion/exclusion	Qualitative, narrative synthesis	Thematic analysis, may include conceptual models

Grant, M. J. (06/2009). *A typology of reviews: An analysis of 14 review types and associated methodologies A typology of reviews,* Blackwell Publishing. doi:10.1111/j.1471-1842.2009.00848.x

Table 1 *Continued*

Label	Description	Methods used (SALSA)			
		Search	Appraisal	Synthesis	Analysis
Rapid review	Assessment of what is already known about a policy or practice issue, by using systematic review methods to search and critically appraise existing research	Completeness of searching determined by time constraints	Time-limited formal quality assessment	Typically narrative and tabular	Quantities of literature and overall quality/direction of effect of literature
Scoping review	Preliminary assessment of potential size and scope of available research literature. Aims to identify nature and extent of research evidence (usually including ongoing research)	Completeness of searching determined by time/scope constraints. May include research in progress	No formal quality assessment	Typically tabular with some narrative commentary	Characterizes quantity and quality of literature, perhaps by study design and other key features. Attempts to specify a viable review
State-of-the-art review	Tend to address more current matters in contrast to other combined retrospective and current approaches. May offer new perspectives on issue or point out area for further research	Aims for comprehensive searching of current literature	No formal quality assessment	Typically narrative, may have tabular accompaniment	Current state of knowledge and priorities for future investigation and research
Systematic review	Seeks to systematically search for, appraise and synthesis research evidence, often adhering to guidelines on the conduct of a review	Aims for exhaustive, comprehensive searching	Quality assessment may determine inclusion/exclusion	Typically narrative with tabular accompaniment	What is known; recommendations for practice. What remains unknown; uncertainty around findings, recommendations for future research
Systematic search and review	Combines strengths of critical review with a comprehensive search process. Typically addresses broad questions to produce 'best evidence synthesis'	Aims for exhaustive, comprehensive searching	May or may not include quality assessment	Minimal narrative, tabular summary of studies	What is known; recommendations for practice. Limitations
Systematized review	Attempt to include elements of systematic review process while stopping short of systematic review. Typically conducted as postgraduate student assignment	May or may not include comprehensive searching	May or may not include quality assessment	Typically narrative with tabular accompaniment	What is known; uncertainty around findings; limitations of methodology
Umbrella review	Specifically refers to review compiling evidence from multiple reviews into one accessible and usable document. Focuses on broad condition or problem for which there are competing interventions and highlights reviews that address these interventions and their results	Identification of component reviews, but no search for primary studies	Quality assessment of studies within component reviews and/or of reviews themselves	Graphical and tabular with narrative commentary	What is known; recommendations for practice. What remains unknown; recommendations for future research

Grant, M. J. (06/2009). *A typology of reviews: An analysis of 14 review types and associated methodologies A typology of reviews,* Blackwell Publishing. doi:10.1111/j.1471-1842.2009.00848.x

Research Process

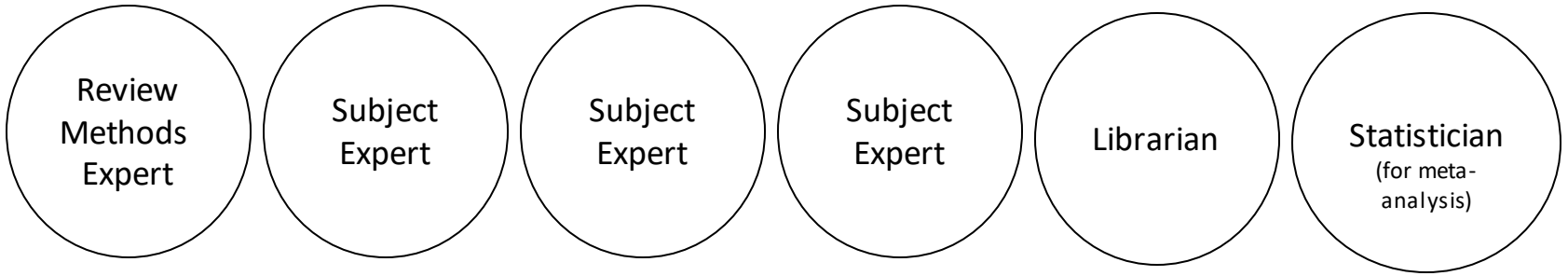
Systematic Review Process

- Question development
- Inclusion/exclusion criteria
- Search for studies
- Review and select studies
- Review study quality
- Data extraction
- Synthesis of results

Team Formation

Ideal Systematic Review Team

- One team member knowledgeable about SR methods
- 2-5 subject experts
- Librarian (information retrieval expertise)
- Statistical expertise (especially if doing quantitative synthesis)



Role of Librarian (Co-investigator)

Study Phase	Activity
Planning	Help development or refinement of review topic (assess the need for a Systematic Review) Search for existing systematic reviews Search for protocols of reviews in progress Help define study “participants”
Conduct	Identification of databases for searches Development and execution of searches Documentation of search strategies Management of search results
Reporting	Write the literature search section in Methods in the protocol and the review Review of other sections or final draft Co-authorship
Updating	All of the above

Role of Librarian (Co-investigator)

- Rethlefsen et al (2015): Among 275 SRs published in general and internal medicine journals, **level of librarian or information specialist participation was significantly associated with search reproducibility, and articles with librarian co-authors were more likely to meet 8 of 13 search standards.**

Rethlefsen ML, Farrell AM, Osterhaus Trzasko LC, Brigham TJ. (2015). Librarian co-authors correlated with higher quality reported search strategies in general internal medicine systematic reviews. *Journal of Clinical Epidemiology*, *68*(6), 617-26

Break

10 minutes

Question Development/Problem Formulation

1. Determine if the topic has been reviewed before
   - Search for other reviews
   - Search for protocols of reviews in progress (ask librarian for help)

2. Clarify your question/s
   - Determine main concepts--including the conceptual and operational definitions
   - What question framework (parameters) fits your review? (e.g. PICO, CHIP, etc.)
   - Identify synonyms (both controlled vocabulary and natural language)

3. Set explicit inclusion/exclusion criteria (generally based on your parameters)
4. Write a protocol

Question Framework

Table 3.3. Frameworks for research questions

Framework	*Stands for*	*Disciplines/type of question*
BeHEMoTh (Booth and Carroll 2015)	Be: behavior of interest H: health context (service/policy/ intervention) E: exclusions MoTh: models or theories	Questions about theories
CHIP (Shaw 2010)	Context How Issues Population	Psychology, qualitative
CIMO (Denyer and Tranfield 2009)	Context Intervention Mechanisms Outcomes	Management, business, administration
CLIP (Wildridge and Bell 2002)	Client group Location of provided service Improvement/Information/ Innovation Professionals (who provides the service?)	Librarianship, management, policy
COPES (Gibbs 2003)	Client-oriented Practical Evidence search	Social work, health care, nursing
ECLIPSE (Wildridge and Bell 2002)	Expectation Client Location Impact Professionals Service	Management, services, policy, social care
PEO (Kahn et al. 2003)	Population Exposure Outcome	Qualitative
PECODR (Dawes et al. 2007)	Patient/population/ problem Exposure Comparison Outcome Duration Results	Medicine
PESICO (Schlosser and O'Neil-Pirozzi 2007)	Person Environments Stakeholders Intervention Comparison Outcome	Augmentative and alternative communication
PICO (Richardson et al. 1995)	Patient Intervention Comparison Outcome	Clinical medicine
PICO+ (Bennett and Bennett 2000)	+context, patient values, and preferences	Occupational therapy
PICOC (Petticrew & Roberts, 2006)	Context	Social sciences
PICOS (Moher et al. 2009)	Study type	Medicine
PICOT (Richardson et al. 1995)	Time	Education, health care
PICO specific to diagnostic tests (Kim et al. 2015)	Patients/participants/ population Index tests Comparator/reference tests Outcome	Diagnostic questions
PIPOH (ADAPTE Collaboration 2009)	Population Intervention Professionals Outcomes Health care setting/ context	Screening
ProPheT (Booth et al. 2016)	Problem Phenomenon of interest Time	Social sciences, qualitative, library science
SPICE (Booth 2004)	Setting Perspective Interest Comparison Evaluation	Library and information sciences
SPIDER (Cooke et al. 2012)	Sample Phenomenon of interest Design Evaluation Research type	Health, qualitative research
WWH	Who What How	

Foster, M.J., & Jewell, S. T. (Eds.). (2017). Assembling the Pieces of a Systematic Review: a Guide for Librarians. Rowman & Littlefield.

Question example (large group activity)

For the question:

Is Cognitive Behavior Therapy more effective at reducing the symptoms than antidepressants?

- What are the main concepts?
- What are some of the synonyms?

Small group activity

For the following question:

Should GPs prescribe antibiotics to treat children with middle ear infections?

What are the main concepts?

What are some of the synonyms related to each concept?

Small group/individual activity

For your research question:

What are the main concepts?

What are some of the synonyms?

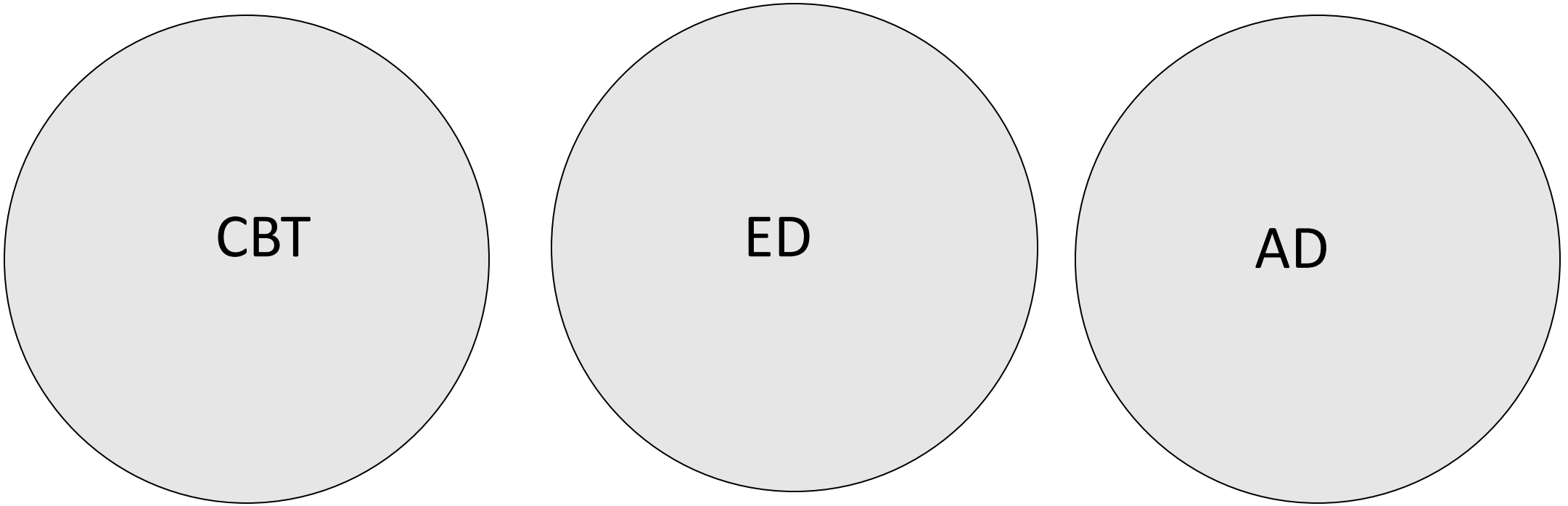
Searching

- Developing a search strategy
- Selecting databases
- Searching the databases
- Documenting the process
- Exporting the results

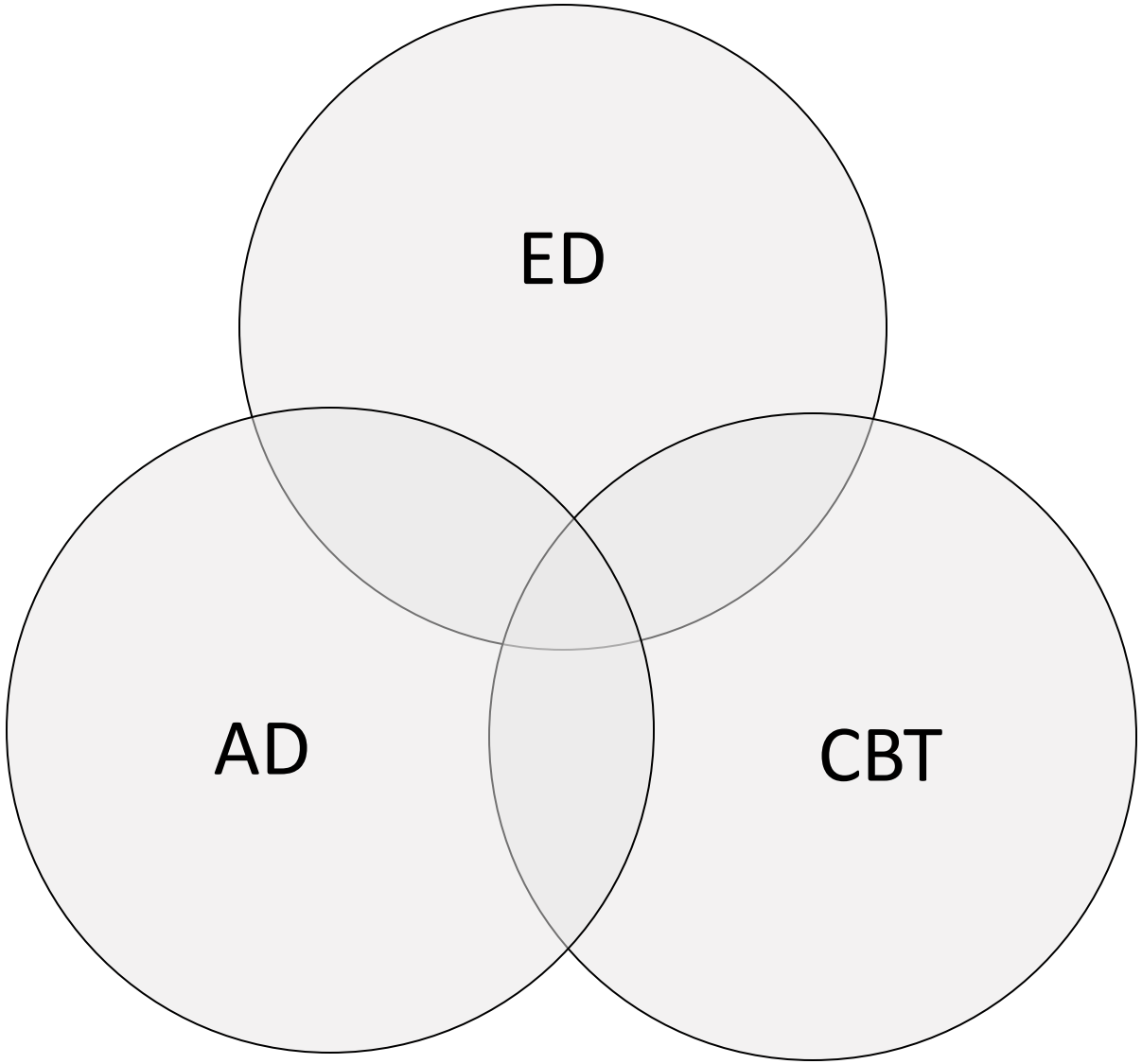
Developing a Search Strategy

- Data collection
- Translate your research question into an effective search strategy
- Comprehension vs. precision

Identifying Search Concepts



Identifying Search Concepts



Selecting Databases

- Use a variety of resources
- Have reasons for your selection
- Include grey literature in your search

List of Common Databases:

- PubMed
- PsycINFO
- ERIC
- Web of Science
- Sociological Abstracts
- Social Work Abstracts
- ProQuest Dissertations and Theses Global (grey literature source)

Searching the Databases

- Each database has a unique search interface and controlled vocabulary
- You will have to adapt your search strategy for each database

PubMed

- Journal citations and abstracts collected from the life sciences literature from 1947 to the present. Over 4,800 journals are indexed in the areas of clinical medicine, biomedicine, and health care.
- MeSH Terms
  - Example:
    - "Antidepressive Agents"[Mesh]
    - "Feeding and Eating Disorders"[Mesh]

NCBI Resources How To Sign in to NCBI

MeSH

MeSH eating disorder Search

Create alert Limits Advanced Help

Summary Send to:

Search results

Items: 2

☑ **Feeding and Eating Disorders**

1. A group of disorders characterized by physiological and psychological disturbances in appetite or food intake.
Year introduced: 2016 (1983)

☐ **Binge-Eating Disorder**

2. A disorder associated with three or more of the following: eating until feeling uncomfortably full; eating large amounts of food when not physically hungry; eating much more rapidly than normal; eating alone due to embarrassment; feeling of disgust, DEPRESSION, or guilt after overeating.

PubMed Search Builder

"Feeding and Eating Disorders"[Mesh]

Add to search builder AND

Search PubMed

YouTube Tutorial

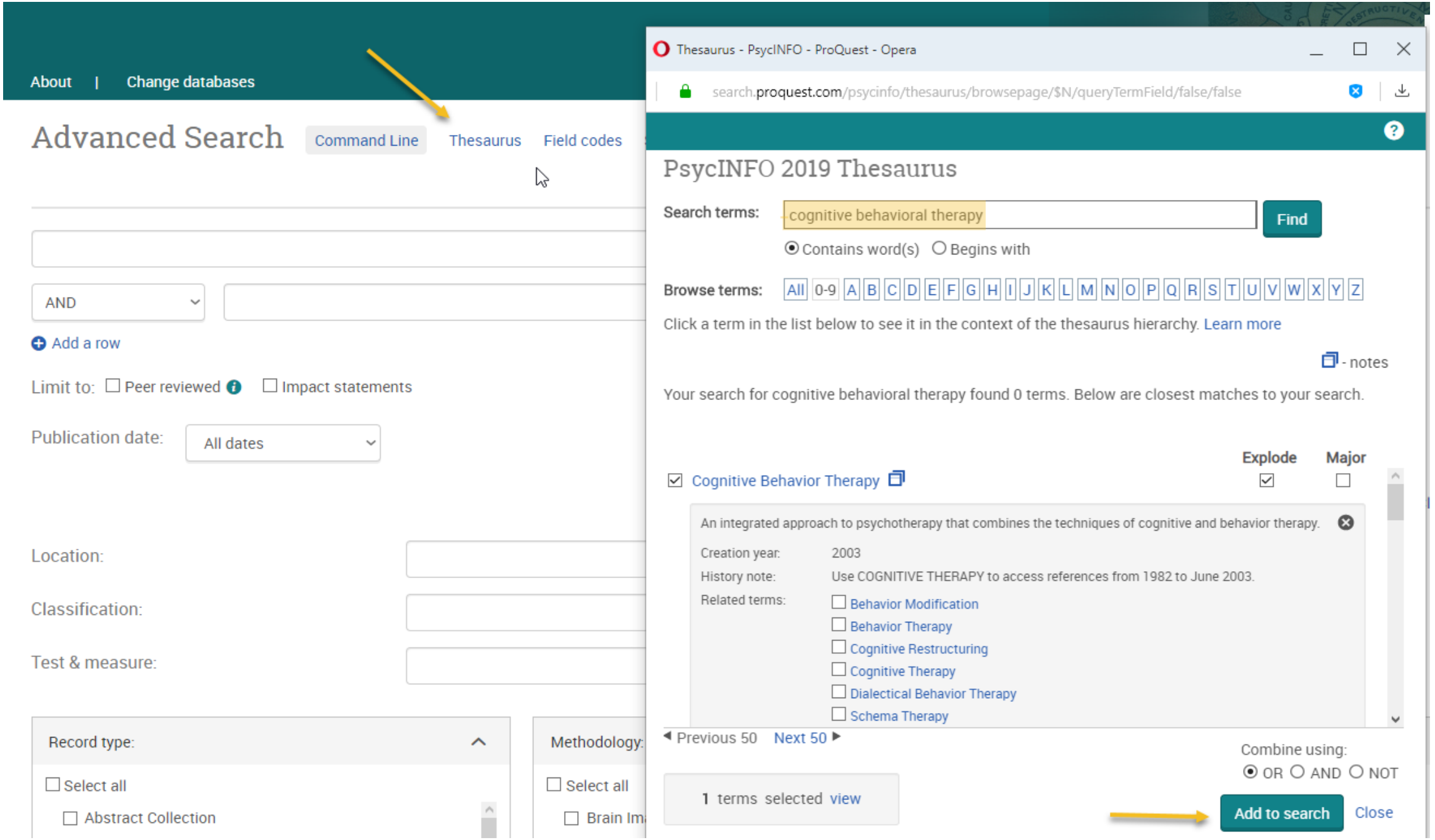
Find related data

Database: Select

Find items

PsycINFO

- Contains citations and summaries of journal articles, book chapters, books, and technical reports, as well as citations to dissertations in psychology and psychiatry. The journal literature spans 1887 to the present
- Use thesaurus
  - Example:
    - MAINSUBJECT.EXACT.EXPLODE("Eating Disorders")
    - MAINSUBJECT.EXACT.EXPLODE("Antidepressant Drugs")
    - MAINSUBJECT.EXACT.EXPLODE("Purging (Eating Disorders)")


About | Change databases
Advanced Search
Command Line
Thesaurus
Field codes
AND
Add a row
Limit to: Peer reviewed Impact statements
Publication date: All dates
Location:
Classification:
Test & measure:
Record type:
Select all
Abstract Collection
Methodology:
Select all
Brain Im
Thesaurus - PsycINFO - ProQuest - Opera
search.proquest.com/psycinfo/thesaurus/browsepage/$N/queryTermField/false/false
PsycINFO 2019 Thesaurus
Search terms: cognitive behavioral therapy
Find
Contains word(s) Begins with
Browse terms: All 0-9 A B C D E F G H I J K L M N O P Q R S T U V W X Y Z
Click a term in the list below to see it in the context of the thesaurus hierarchy. Learn more
- notes
Your search for cognitive behavioral therapy found 0 terms. Below are closest matches to your search.
Explode
Major
Cognitive Behavior Therapy
An integrated approach to psychotherapy that combines the techniques of cognitive and behavior therapy.
Creation year: 2003
History note: Use COGNITIVE THERAPY to access references from 1982 to June 2003.
Related terms:
Behavior Modification
Behavior Therapy
Cognitive Restructuring
Cognitive Therapy
Dialectical Behavior Therapy
Schema Therapy
Previous 50
Next 50
Combine using:
OR AND NOT
1 terms selected view
Add to search
Close

Documenting the Search

- Document the actual search strategy used (export/copy from the database)
- Document search terms and results yourself to help develop with the development of the search strategy and with reporting
- PRISMA flowchart to document process from the search results on

PubMed Search

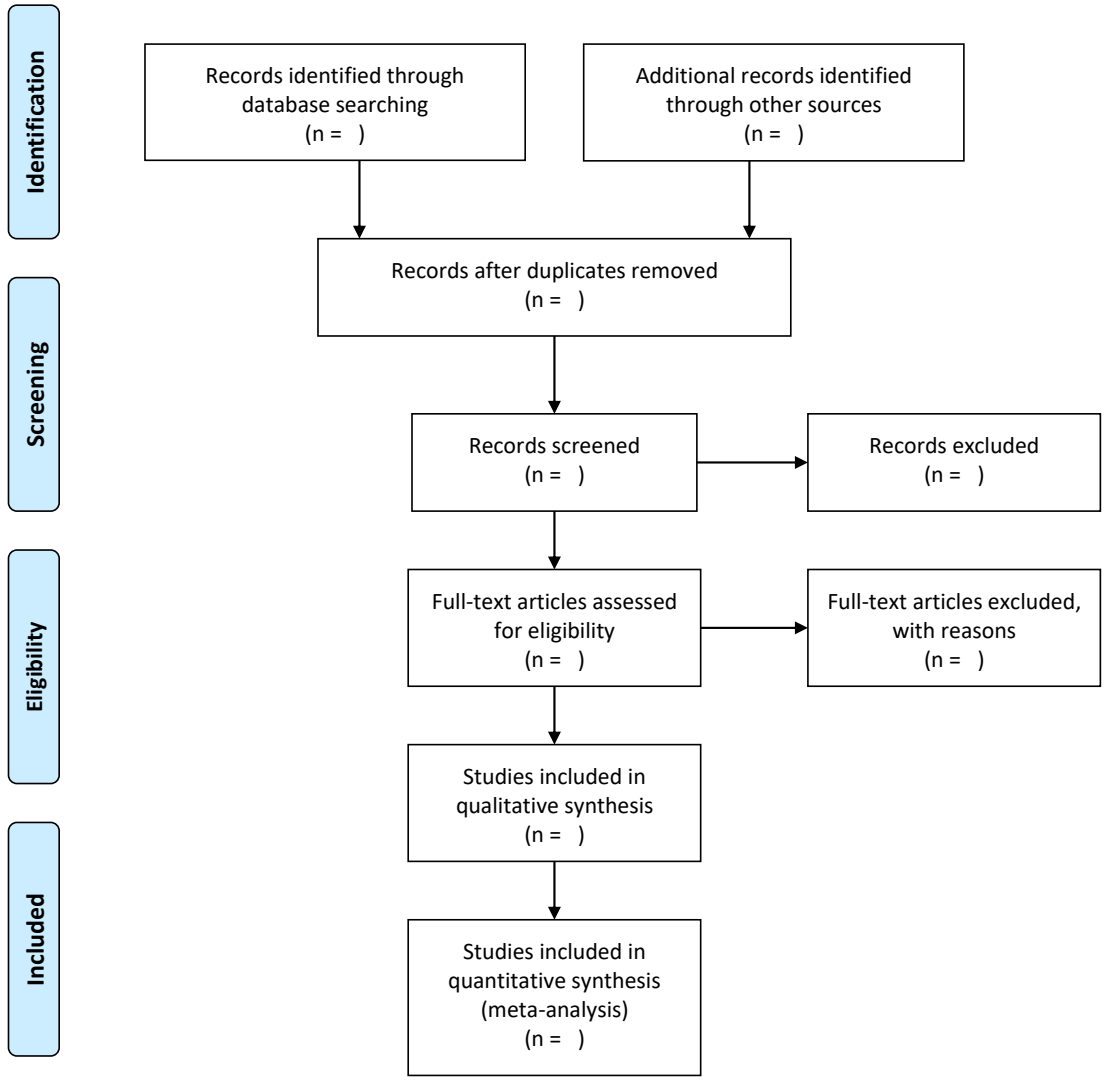
((("Antidepressive Agents"[Mesh] OR "Antidepressive Agents, Tricyclic"[Mesh] OR "Antidepressive Agents, Second-Generation"[Mesh] OR "Fluvoxamine"[Mesh] OR "Bupropion"[Mesh] OR "Citalopram"[Mesh] OR "Serotonin and Noradrenaline Reuptake Inhibitors"[Mesh])) AND "Cognitive Behavioral Therapy"[Mesh]) AND ((("Feeding and Eating Disorders"[Mesh]) or "Binge-Eating Disorder"[Mesh]))

Documenting the Search

	A	B	C	D	E	F	G	H	I	J	K	L
1	**Search**	**Results**	**Search Term**	**Results**	**Search Term**	**Results**	**Combined**					
2	MAINSUBJECT.EXACT.EXPLODE("Eating Disorders")	29747	MAINSUBJECT.EXACT.EXPLODE("Cognitive	20060	MAINSUBJECT.EXACT.EXPLODE("Anti depressant Drugs")	37588	eating disorders	51691				
3	MAINSUBJECT.EXACT.EXPLODE("Binge Eating Disorder")	1648	MAINSUBJECT.EXACT.EXPLODE("Cognitive	13256	MAINSUBJECT.EXACT("Serotonin Reuptake Inhibitors")	4987	CBT	46676				
4	MAINSUBJECT.EXACT.EXPLODE("Anorexia Nervosa")	10850	noft(cbt)	13356	MAINSUBJECT.EXACT.EXPLODE("Fluoxetine")	3732	Antidepressants	57772				
5	MAINSUBJECT.EXACT.EXPLODE("Bulimia")	7506	noft(cognitive	46672	noft(prozac)	330						
6	MAINSUBJECT.EXACT.EXPLODE("Pica")	248			noft(SSRI)	6424						
7	noft(eating disorders)	48637	combined	46676	noft(antidepressants)	40980	combined w/ AND	129				
8		98636										
9	combined	51691			combined	57772						
10												
11												
12												
13												
14												
15												
16												
17												
18												
19												

psycinfo

PRISMA 2009 Flow Diagram



Exporting the Search

- EndNote
- Zotero

Group Activity

Develop a search strategy for the second question on the PICO or one of your own research questions:

- Choose databases
- Identify the search concepts
- Begin brain drafting the search terms using controlled vocabulary

Study Rationale

Evidence-based Practice (EBP)
Is a “lifelong problem-solving approach to clinical practice” that results in higher quality of health care and greater client benefit (Melynk & Fineaut-Overholt, 2015)

Clinician expertise and wisdom

Integration of the best and most relevant **research**

Client preferences and values

Requires development of **research skills**

Undergraduate Research Experiences (URE)
are high impact practices in higher education with documented learning outcomes that attempt to meet the complex and varied demands of a changing world (Gagliardi, Martin, Wise, & Blaich, 2015; Kuh, 2008).

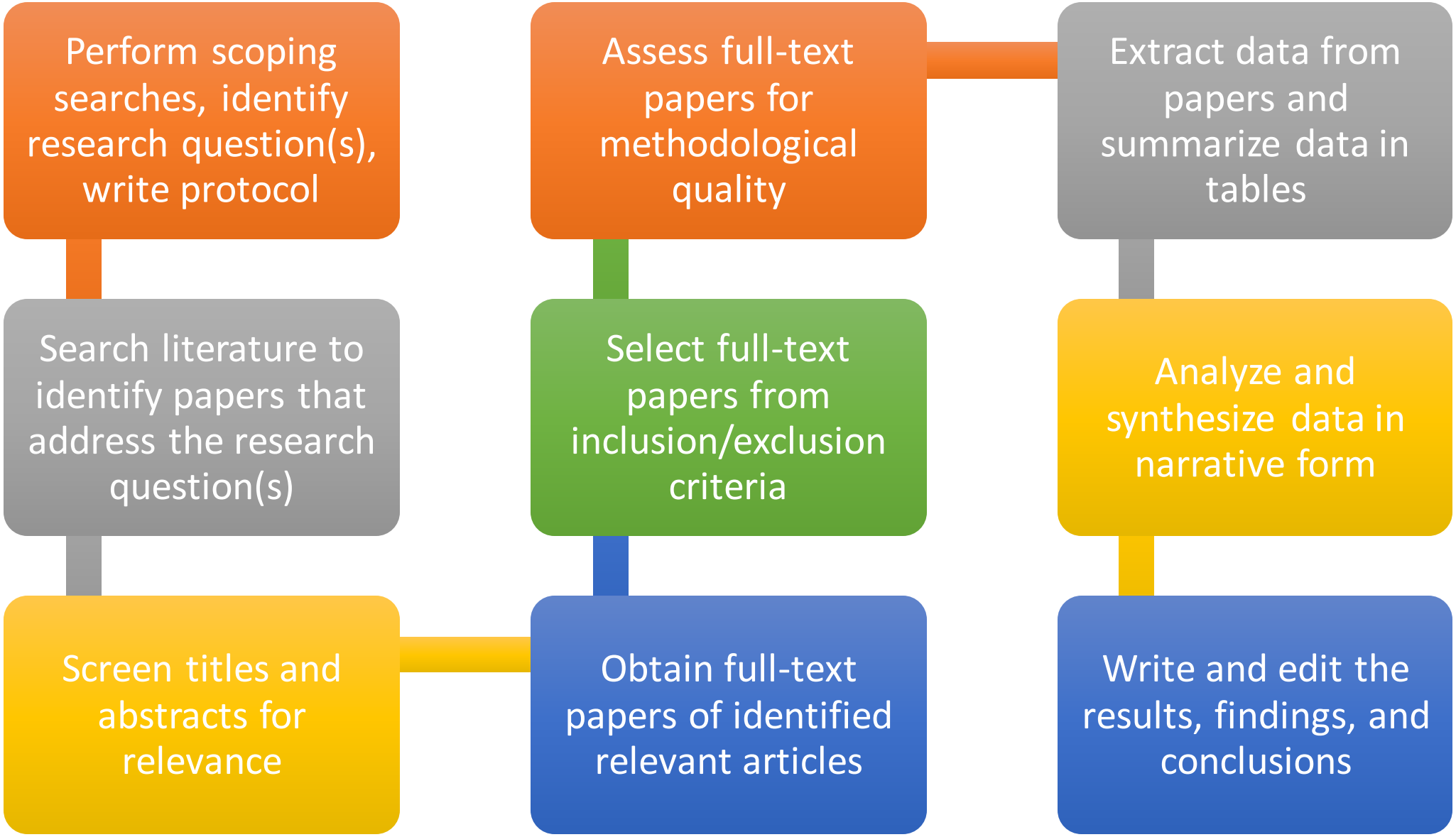
AMTA Music Therapy Research 2025 initiative to build research capacity and infrastructure and encourage development of clinician-scholars (AMTA, 2015)

Research Skill Development within the Curriculum may be the most inclusive, efficient, and cost-effective ways to provide this level of research training to the largest number of students (Shanahan, 2012)

Course-based Undergraduate Research Experiences (CURE)
engage an entire class of students in addressing a research question or problem of interest to the profession with an outcome that is unknown to both students and instructor (Auchincloss et al., 2014).

- student involvement in the use and integration of scientific practices
- discovery of new knowledge or insights
- broadly relevant or important work with impact beyond the classroom
- collaboration with others to improve intellectual, communication, and metacognition skills
- iterative processes in which new knowledge builds on existing knowledge

Systematic Review (Boland et al., 2014)



Purpose and Research Questions

- Purpose Statement
  - The purpose of this systematic review is to summarize and describe course-based research experiences and discuss implications and best practices for inclusion in music therapy education and training.

- Research Questions
  - What are the characteristics of course-based undergraduate research experience characteristics experiences (i.e., participants, grade level, course, field of study, course type, duration, terminology, study design)?
  - What are the outcomes of course-based undergraduate research experiences and how are these outcomes measured?

Dvorak, A. L., Davis, J., Bernard, G., Beveridge-Calvin, R., Monroe-Gulick, A., Thomas, P., & Forstot-Burke, C. (in press) Systematic review of course-based undergraduate research experiences: Implications for music therapy education. *Music Therapy Perspectives.*

Team Formation

- Librarians
  - Amalia Monroe-Gulick, MS, MLS
  - Paul Thomas, MA
  - Corinne Forstot-Burke, MSI
- Students
  - Julia Davis
  - Gabriella Bernard
  - Riley Beveridge-Calvin
  - Melissa Gillespie
  - Allison Nocita
  - Emily Nordhues

Three Databases

- ERIC
- PubMed
- Web of Science

Three Searches

- Course based
  AND
- Research
  AND
- Undergraduates

Journal Indexing in Databases

Journal	WOS	PubMed	ERIC	CINHAL	PscyINFO	Academic Search
Biochemistry and Molecular Biology Education	1	1	1	0	0	0
Yeast	1	1	0	0	0	0
CBE—Life Sciences Education	1	1	1	0	0	0
JOURNAL OF MEDICAL EDUCATION AND CURRICULAR DEVELOPMENT	1	0	0	0	0	1
CANADIAN JOURNAL FOR THE SCHOLARSHIP OF TEACHING AND LEARNING	1	0	1	0	0	0
CHEMISTRY EDUCATION RESEARCH AND PRACTICE	1	0	1	0	0	0
AMERICAN BIOLOGY TEACHER	1	1	1	0	0	1
ZEBRAFISH	1	1	0	0	0	0
JOURNAL OF CHEMICAL EDUCATION	0	1	1	0	0	1
Journal of College Science Teaching	0	1	1	0	0	1
MBio	1	1	0	0	0	0
Journal of Nursing Education	1	1	0	1	0	0
Journal of Engineering Education	1	0	0	0	0	1
Teaching of Psychology	1	1	1	0	1	1
Journal of Research in Science Teaching	1	1	1	0	0	0
Journal of Science Education and Technology	1	1	1	0	1	1
Journal of College Student Development	1	1	1	1	0	0
Higher Education Research & Development	1	0	1	0	1	1
Journal of Microbiology & Biology Education	0	1	0	0	0	0
Science Education	1	1	1	0	1	1
Medical education	0	1	0	1	1	1
Journal of Natural Resources & Life Sciences Education	0	0	1	0	0	0
Medical teacher	1	0	1	0	0	0
International Journal of Research & Method in Education	1	0	1	0	0	1
Nursing Education Perspectives	1	1	0	1	0	1
New Directions for Teaching and Learning	0	0	1	0	0	1
Educational researcher	1	0	1	0	0	1
Journal of advanced nursing	1	1	0	1	1	1

ERIC Search = Course based

Search Term	Number of Results
course based	563
SU.EXACT("Courses")	2531
SU.EXACT("Science Experiments")	7382
SU.EXACT("Educational Experiments")	1627
SU.EXACT("Scientific Methodology")	3257
SU.EXACT("Science Curriculum")	9348
SU.EXACT("College Curriculum")	6148
SU.EXACT("Scientific Research")	6453
SU.EXACT("Science Process Skills")	2734
SU.EXACT("Curriculum Implementation")	1984
SU.EXACT("Scientific Principles")	4278
classroom based	1705
class based	285
SU.EXACT("STEM Education")	2980
SU.EXACT("Learning Experience")	6939
SU.EXACT("Curriculum Research")	2199
course-embedded	56
SU.EXACT("Integrated Curriculum")	7593
SU.EXACT("Educational Methods")	3085
SU.EXACT("Problem Based Learning")	3327
SU.EXACT("Student Educational Objectives")	5880
curriculum based	2379
SU.EXACT("Curriculum Design")	12633
SU.EXACT("Classroom Research")	4254
SU.EXACT.EXPLODE("Active Learning")	5970
SU.EXACT.EXPLODE("Learner Engagement")	7812
Combined with OR	100989

ERIC Search = Research and Undergraduates

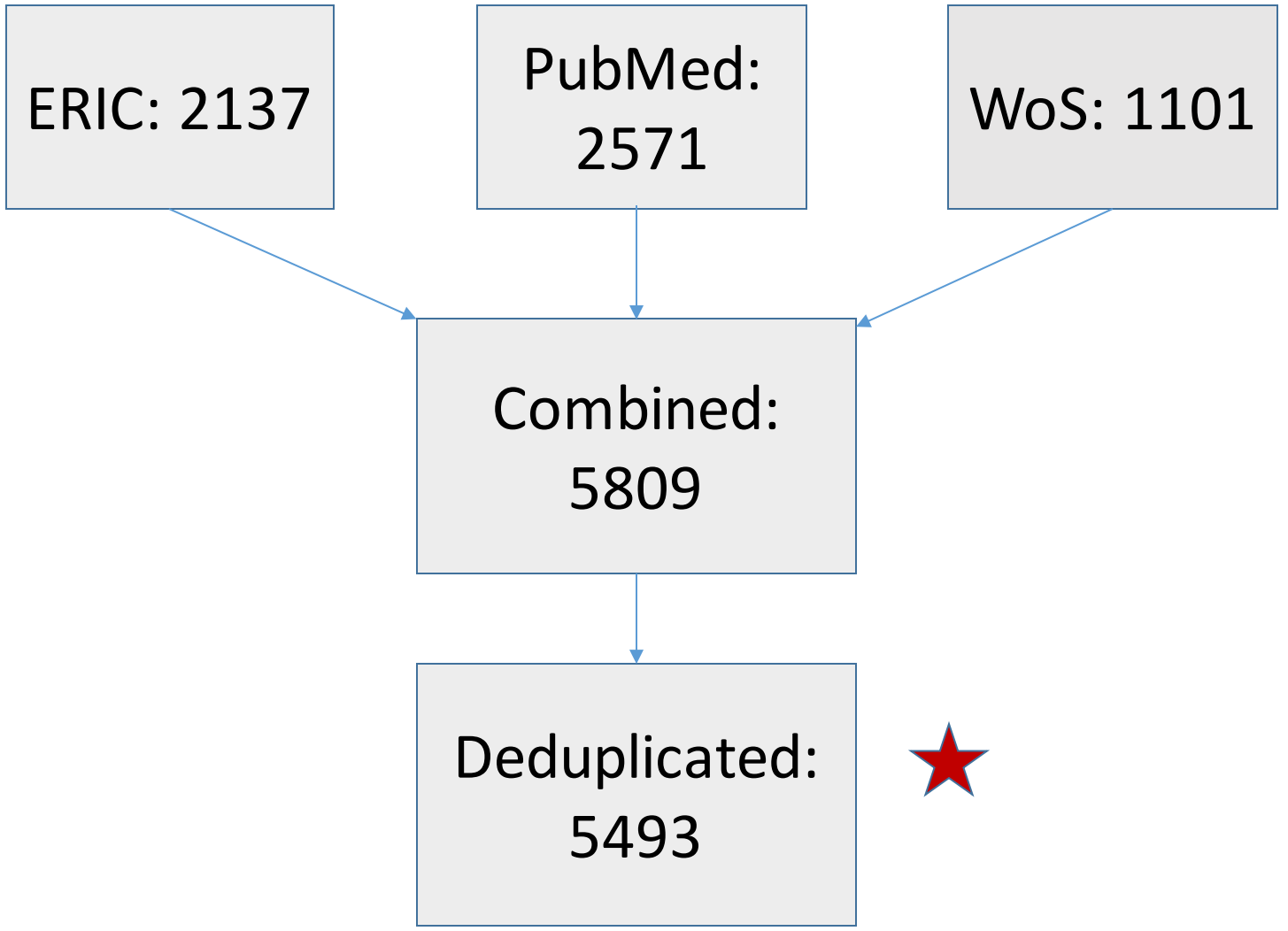
Search Term	Number of Results
SU.EXACT("Research Opportunities")	1320
SU.EXACT("Research Projects")	13807
SU.EXACT.EXPLODE("Research Skills")	2849
SU.EXACT.EXPLODE("Student Research")	4430
SU.EXACT("Research")	16131
research*	581939
Combined with OR	*581939*

Search Term	Number of Results
undergraduate research experience*	141
SU.EXACT("Undergraduate Study")	12289
SU.EXACT.EXPLODE("Undergraduate Students")	24635
undergraduate*	55911
combined with OR	*55989*

ERIC Final Results

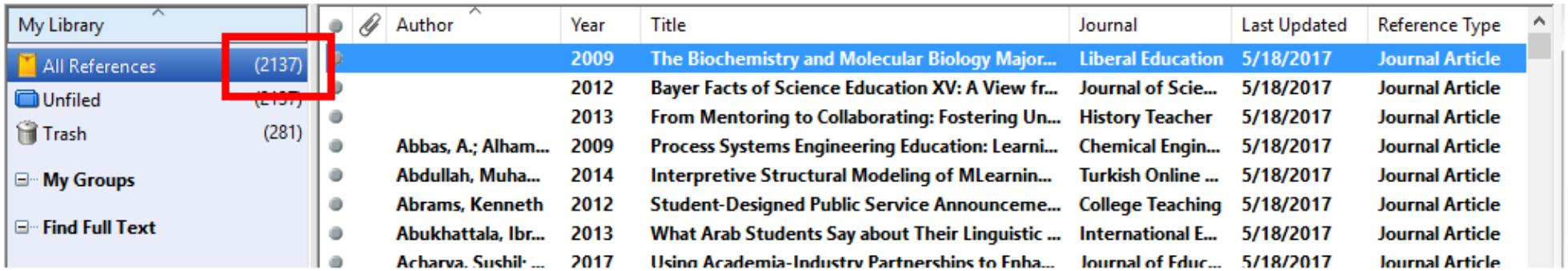
Searches	Number of Results
Search 1: course based results	100989
Search 2: research results	581939
Search 3: undergraduate results	55989
All searches combined with "and"	3909
Filters	
Language: English	3909
Peer Reviewed: Yes	2876
Year: 2000-Present	2547
Source Type: Scholarly Journals	2532
Document Type - Journal Articles	2532
Education Level: Higher Ed, Postsecondary Ed, Adult Ed, Two Year College	2419
Citations exported to Endnote	2418
Duplicates within ERIC deleted	2137
ERIC citations within Endnote	*2137*

Results from Database Searches

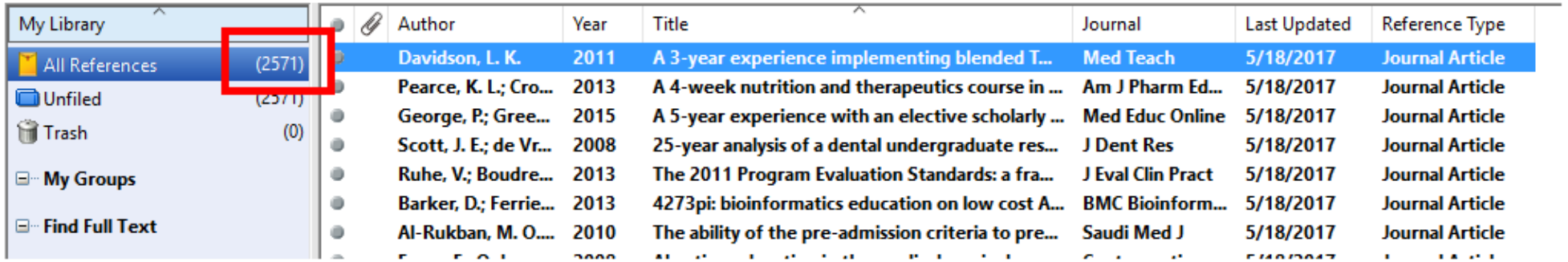


Combining EndNote Libraries

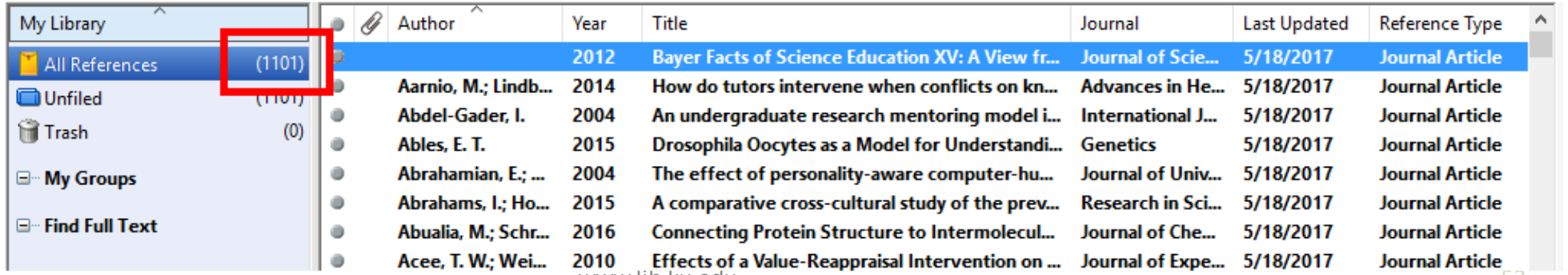
ERIC



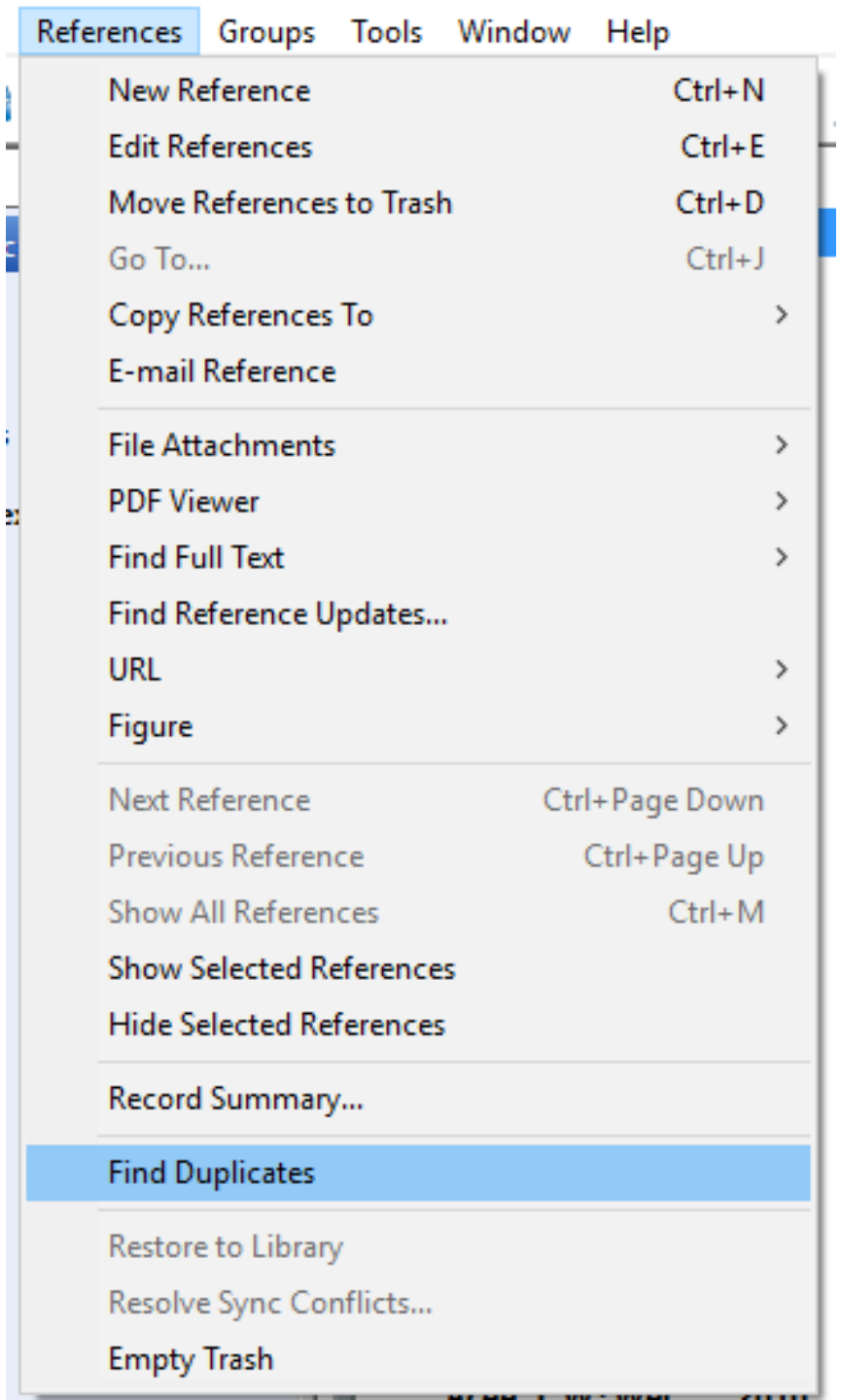
PubMed



Web of Science

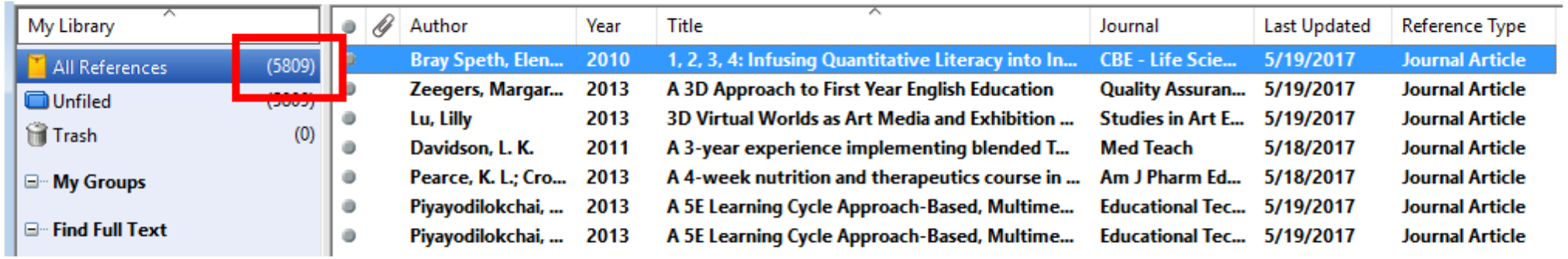


Deduplication of EndNote Libraries

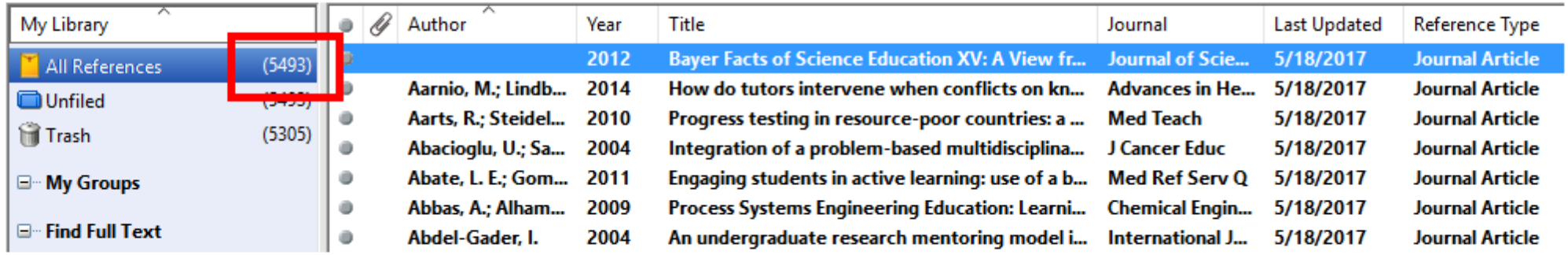


Deduplication of EndNote Libraries

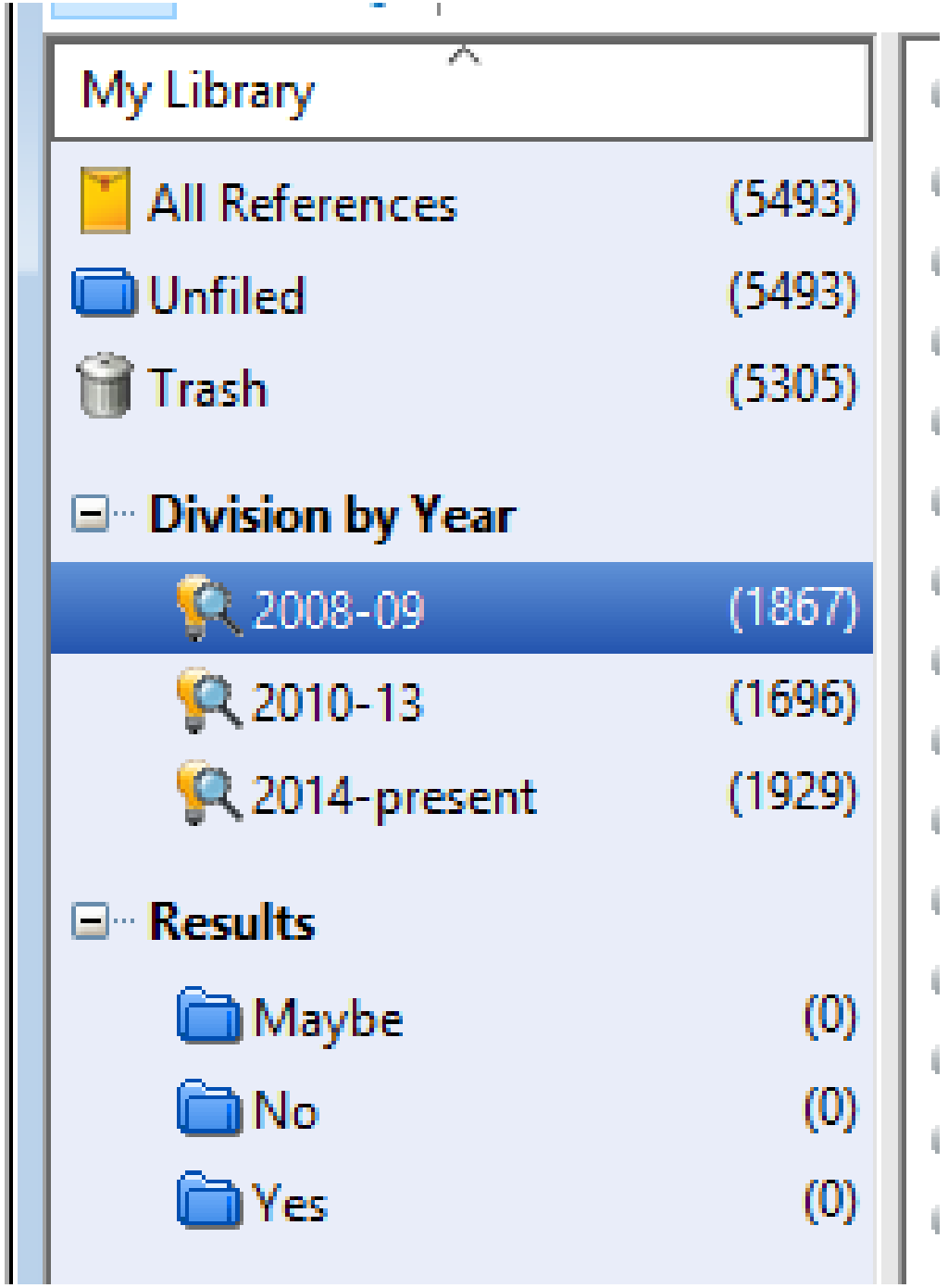
Pre-Deduplication



Post-Deduplication



Using Groups to Aid Sorting Process



Electronic Database Search

ERIC, PubMed, and Web of Science using “course based” AND “research” and “undergraduate” searches

Search Filters

English language, peer-reviewed, scholarly journals (source type), journal articles (document type), published between 2000-2017, education level of higher education, postsecondary, adult education, and two year college.

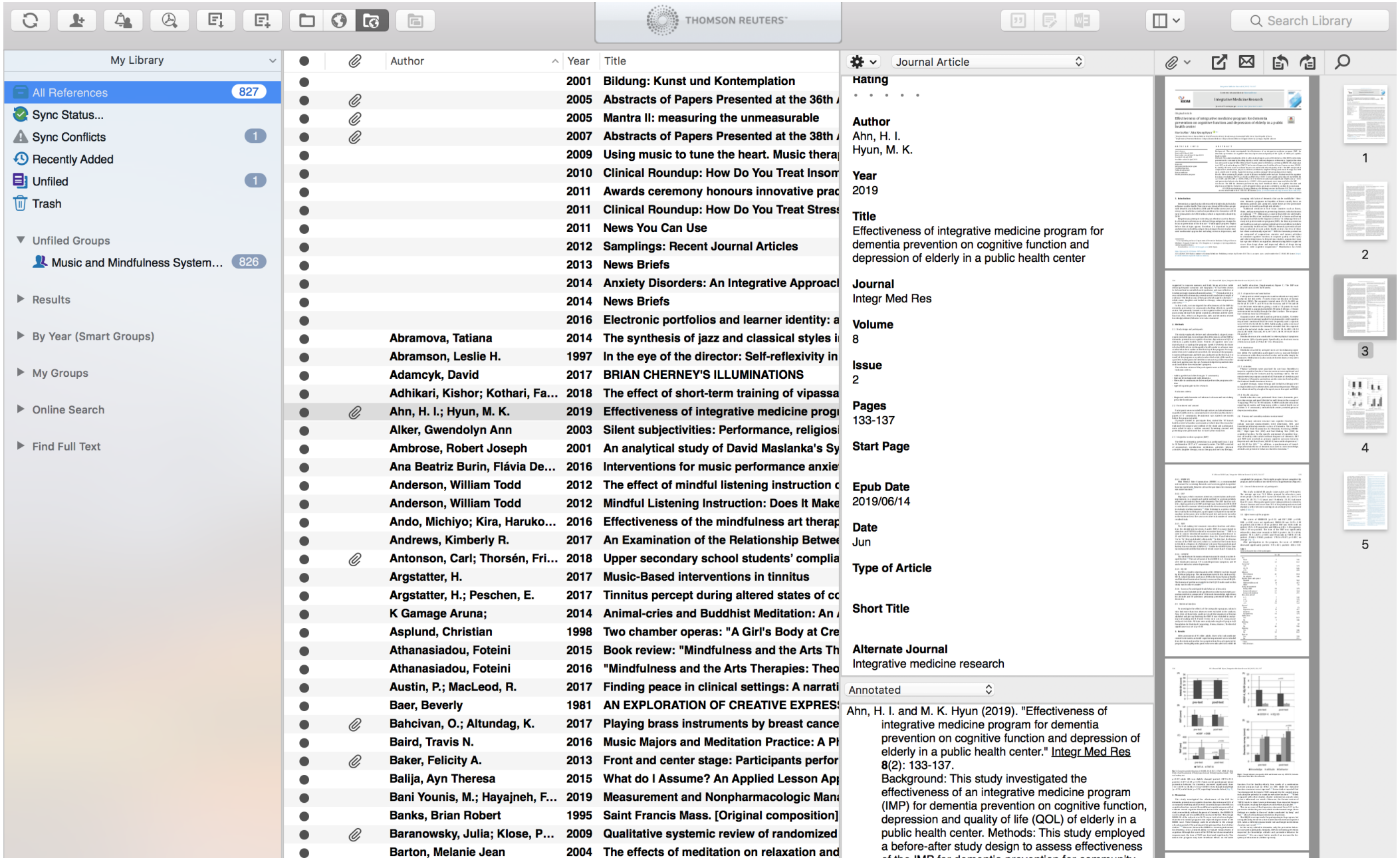
Inclusion Criteria

(a) Published quantitative, qualitative, or mixed methods studies
(b) Involved undergraduate students in research
(c) Used a course-based undergraduate research experience

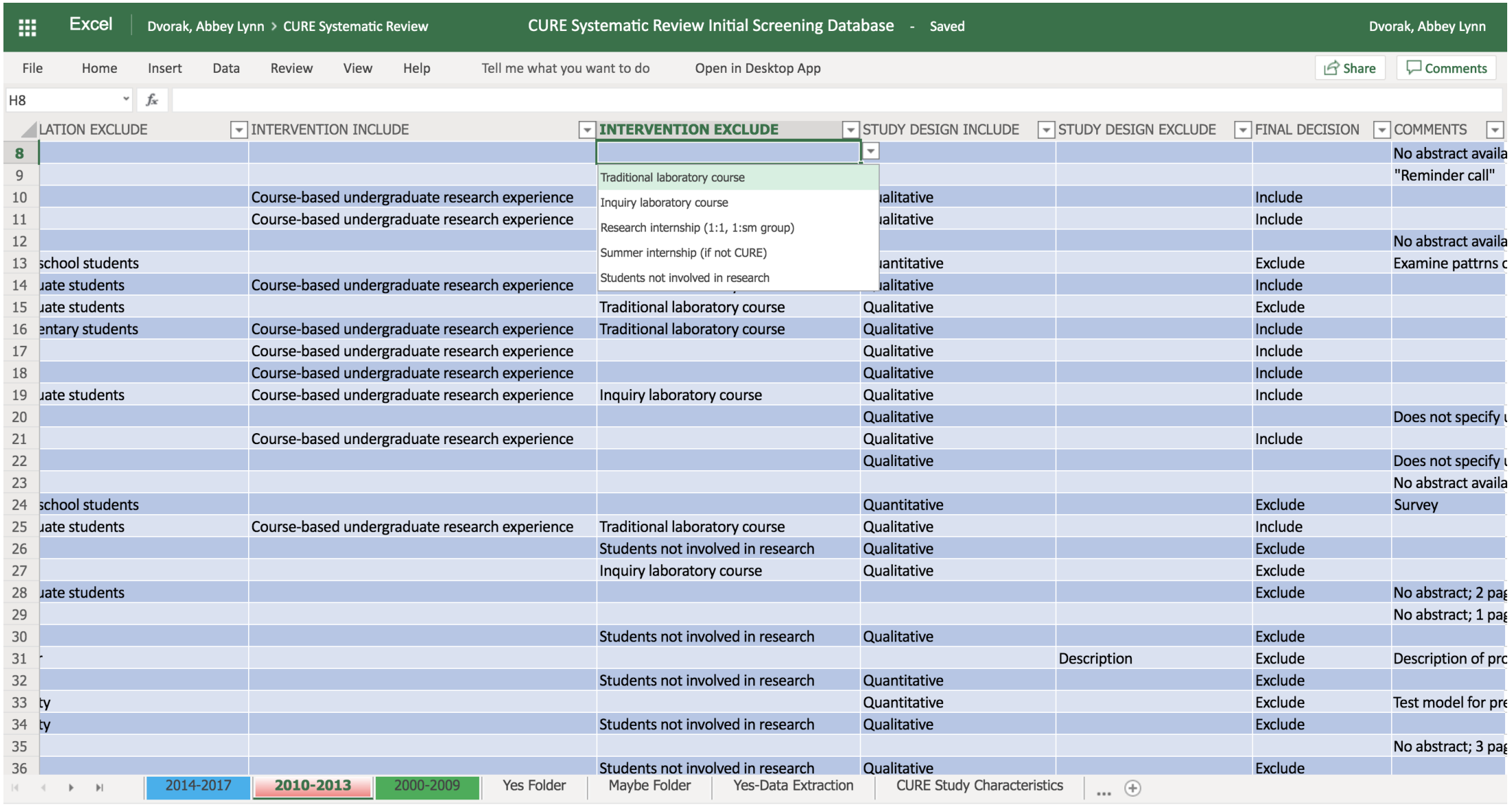
Exclusion Criteria

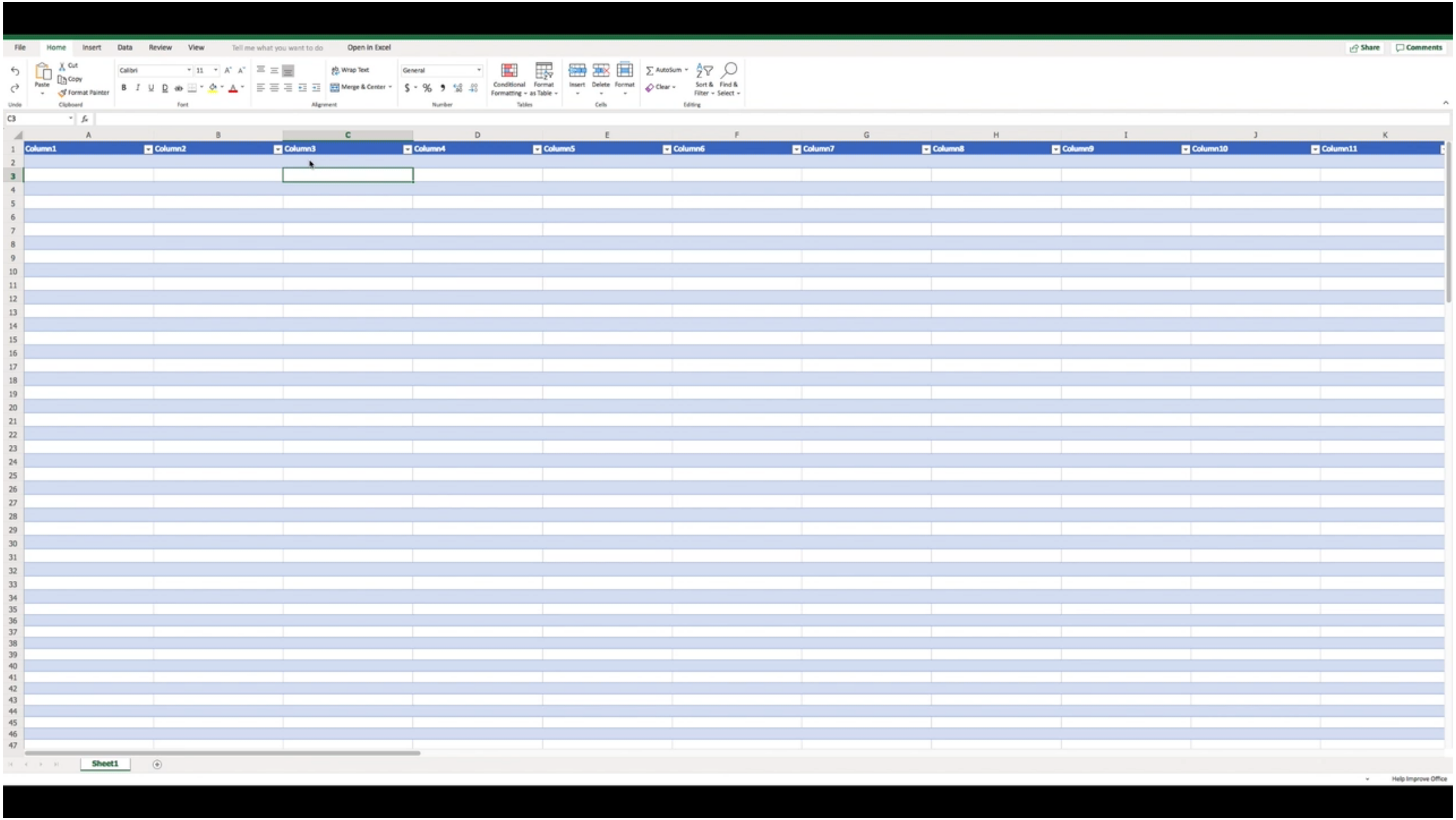
Articles were excluded if they included: (a) a book, book review, book chapter, description, or meeting abstract; (b) elementary, middle, high school, or graduate students; or (c) a non-CURE (i.e., traditional laboratory course, inquiry laboratory course, research or summer internship, students uninvolved in research).

Endnote Library



OneDrive Excel Document




File
Home
Insert
Data
Review
View
Tell me what you want to do
Open in Excel
Share
Comments
Paste
Cut
Copy
Format Painter
Calibri
11
Wrap Text
Merge & Center
General
Conditional Formatting
Format as Table
Insert
Delete
Format
AutoSum
Clear
Sort & Filter
Find & Select
C3
Column1
Column2
Column3
Column4
Column5
Column6
Column7
Column8
Column9
Column10
Column11
Sheet1
Help Improve Office

PRISMA Flow Diagram

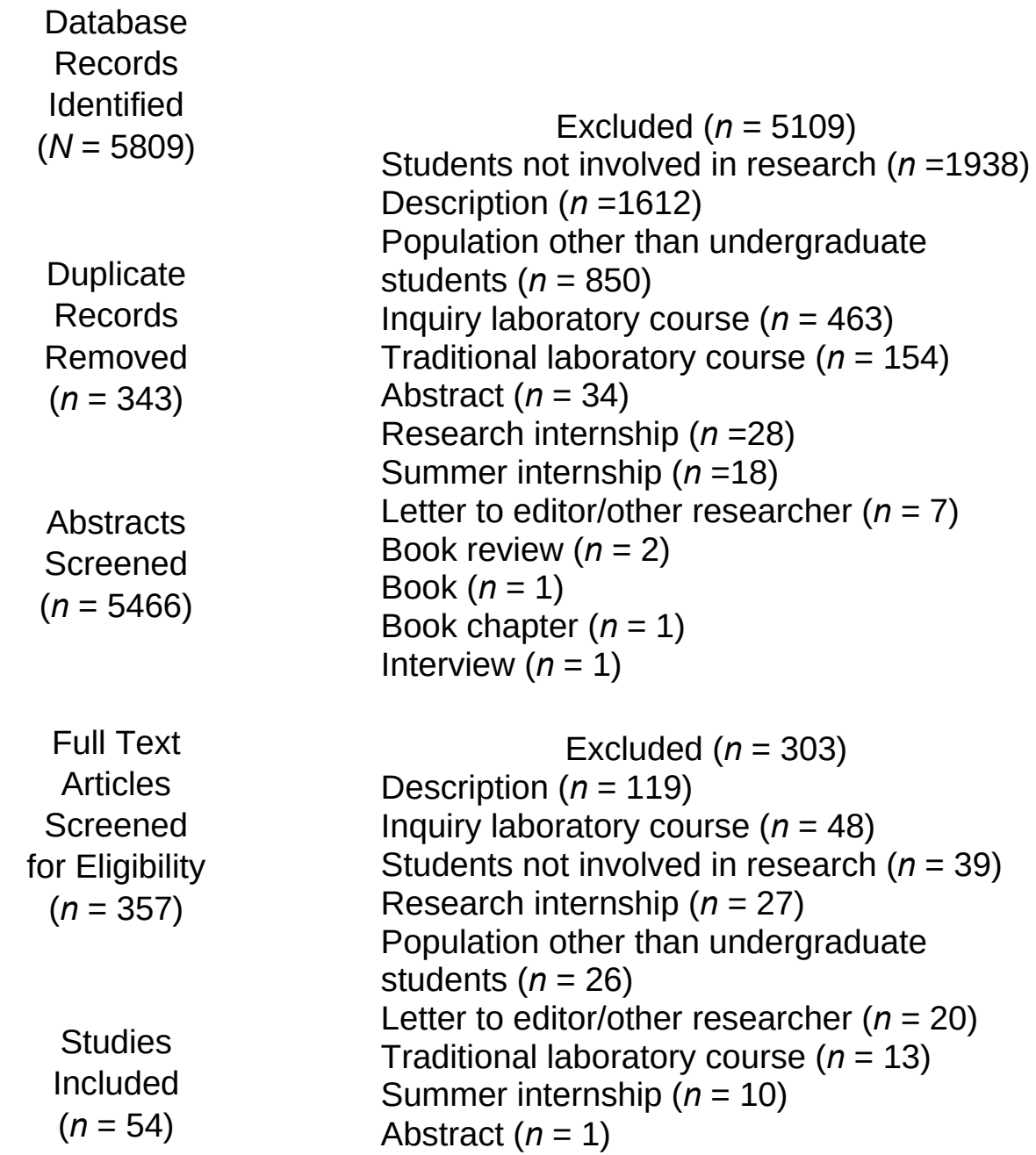
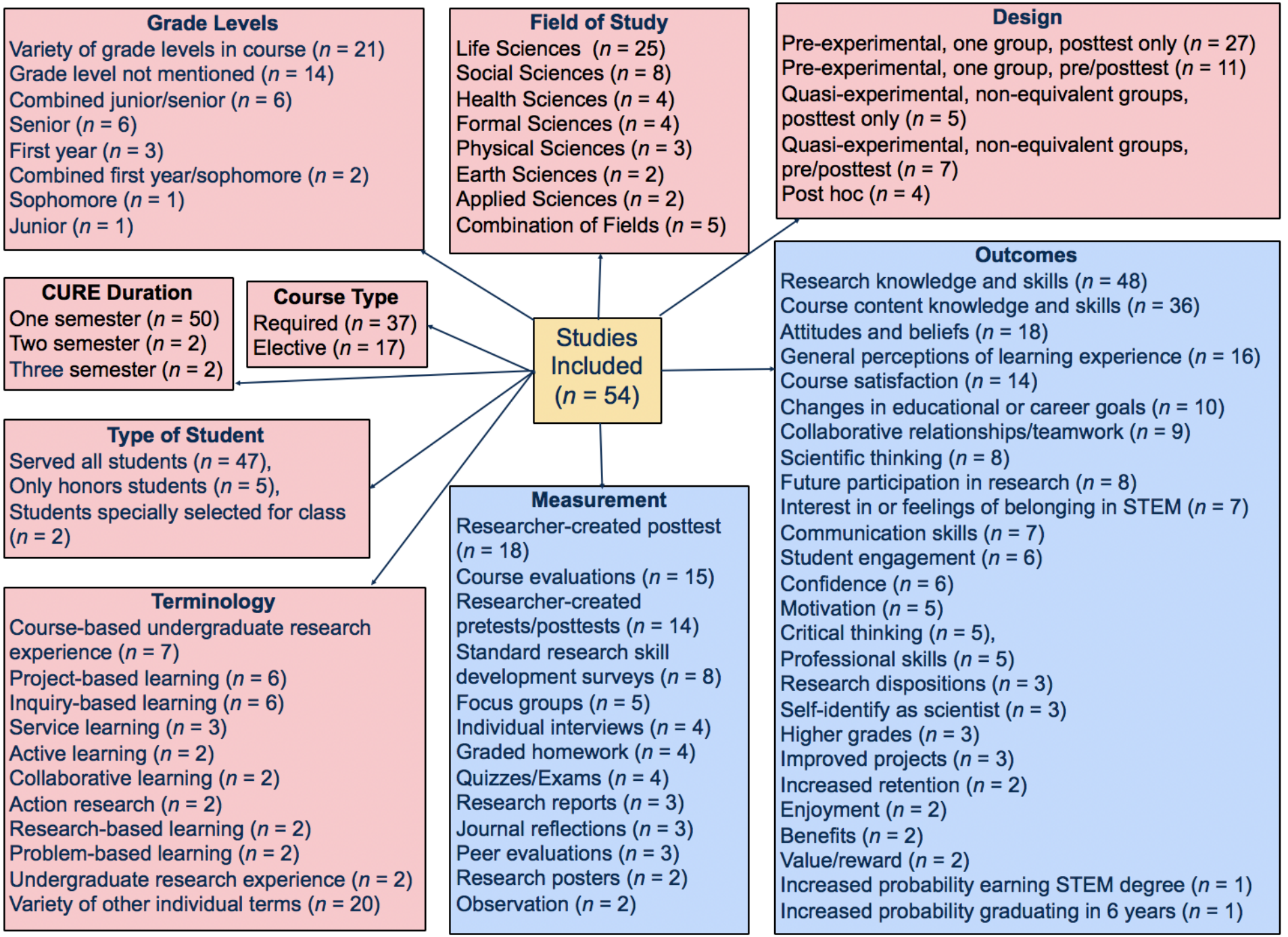


Figure 1: PRISMA Flow Diagram

Dvorak, A. L., Davis, J., Bernard, G., Beveridge-Calvin, R., Monroe-Gulick, A., Thomas, P., & Forstot-Burke, C. (in press) Systematic review of course-based undergraduate research experiences: Implications for music therapy education. *Music Therapy Perspectives.*

Results of the Systematic Review Data Extraction



Dvorak, A. L., Davis, J., Bernard, G., Beveridge-Calvin, R., Monroe-Gulick, A., Thomas, P., & Forstot-Burke, C. (in press) Systematic review of course-based undergraduate research experiences: Implications for music therapy education. *Music Therapy Perspectives.*

Writing the Manuscript

- Title Page – Key words important
- Abstract – Follow instructions exactly
- Introduction/Review of Literature
  - Research Problem and Need for the Study
  - Theoretical Framework and Variables
  - Summarize Known and Unknown
  - Provide Clear Argument for Study
  - Purpose Statement and Research Questions
- Method
  - Study Design – Type of systematic review, description, rationale
  - Searching – Databases, search terms, search filters, deduplication
  - Selection – Inclusion and exclusion criteria, procedure (title/abstract, full text, quality, risk of bias)
- Results
  - Description of Studies
  - Results by Research Question
  - Tables, Figures, Appendices, Online Supplemental
- Discussion
  - Major Findings – Compare and contrast with literature in the field
  - Limitations, Delimitations, and Assumptions – Current study and reviewed studies
  - Future Recommendations – Future research priorities and agenda

Summary of Results Table

Table 1

Summary of Included Studies in the CURE Systematic Review

Reference	Grade Level	Course	Field	Course Type	CURE Duration	Terminology	Design	Measurement	Outcomes
Bowlick, Bednarz, & Goldberg (2016)	Junior, senior, graduate	Introductory GIS course	Geographic Information Systems	Required	One semester	Project-Based Learning	Pre-experimental one group post-test only	Researcher-created posttest, course evaluations, individual interviews	Benefits, value/reward
Bowling, Schultheis, & Strome (2016)	Sophomores, juniors, seniors, post-baccalaureate	Required Genetics course	Biology	Required	One semester	Course-Based Research Experience	Pre-experimental one group post-test only	Researcher-created posttest, quizzes, reports, presentations	Research knowledge and skills, course content knowledge and skills, perception of experience
Boyd, Fernheimer, & Dixon (2015)	Course 1: freshmen; Course 2: sophomores	Course 1: Honors writing course; Course 2: Required writing course	History	Required	One semester	Experiential Learning Method	Post hoc	Reflective essay	Course content knowledge and skills, perception of experience
Braunsberger & Flamm (2013)	Not specified	Marketing Research course	Marketing	Required	One semester	Service Learning	Quasi-experimental, nonequivalent groups	Researcher-created pretest/posttest, GPA, peer evaluations	Research knowledge and skills, course content knowledge and skills, attitudes/beliefs, collaborative relationships/teamwork
Caccavo (2011)	Sophomores, juniors, seniors	Environmental Microbiology	Biology	Elective	One semester	Open-ended, Inquiry-Based Learning	Pre-experimental one group post-test only	Researcher created pretest/posttest	Research knowledge and skills, course content knowledge and skills, perception of experience, collaborative relationships/teamwork
Carboni, Wynn, & McGuire (2007)	Seniors	Research and Reflective Practice in the Elementary Classroom	Education	Required	One semester	Action Research	Post hoc	Journal reflections	Research knowledge and skills, attitudes/beliefs
Chase et al. (2017)	Not specified	Advanced General	Chemistry	Required	One semester	(CURE) Course Based	Pre-experimental one group	Researcher created	Research knowledge and skills, course content knowledge and skills,

Dvorak, A. L., Davis, J., Bernard, G., Beveridge-Calvin, R., Monroe-Gulick, A., Thomas, P., & Forstot-Burke, C. (in press) Systematic review of course-based undergraduate research experiences: Implications for music therapy education. *Music Therapy Perspectives.*

Frequency of CURE Study Characteristics Table

Table 2

Frequency of CURE Study Characteristics

Category	Number	%
Participants		
Served all students	47	87.0%
Only honors students	5	9.3%
Students specially selected for class	2	3.7%
Grade Levels		
Variety of grade levels within same course	21	38.9%
Grade level not mentioned	14	25.9%
Combined junior/senior	6	11.1%
Senior	6	11.1%
First year	3	5.6%
Combined first year/sophomore	2	3.7%
Sophomore	1	1.9%
Junior	1	1.9%
Field of Study		
Life Sciences	25	46.3%
Social Sciences	8	14.8%
Health Sciences	4	7.4%
Formal Sciences	4	7.4%
Physical Sciences	3	5.6%
Earth Sciences	2	3.7%
Applied Sciences	2	3.7%
Combination Life Science/Physical Science	2	3.7%
Combination Life/Science/Applied Science	1	1.9%
Combination Formal Science/Applied Science	1	1.9%
Combination Physical Science/Earth Science	1	1.9%
Combination of Three or More Sciences	1	1.9%
Course Type		
Required	37	68.5%
Elective	17	31.5%

Dvorak, A. L., Davis, J., Bernard, G., Beveridge-Calvin, R., Monroe-Gulick, A., Thomas, P., & Forstot-Burke, C. (in press) Systematic review of course-based undergraduate research experiences: Implications for music therapy education. *Music Therapy Perspectives.*

PRISMA Flow Diagram

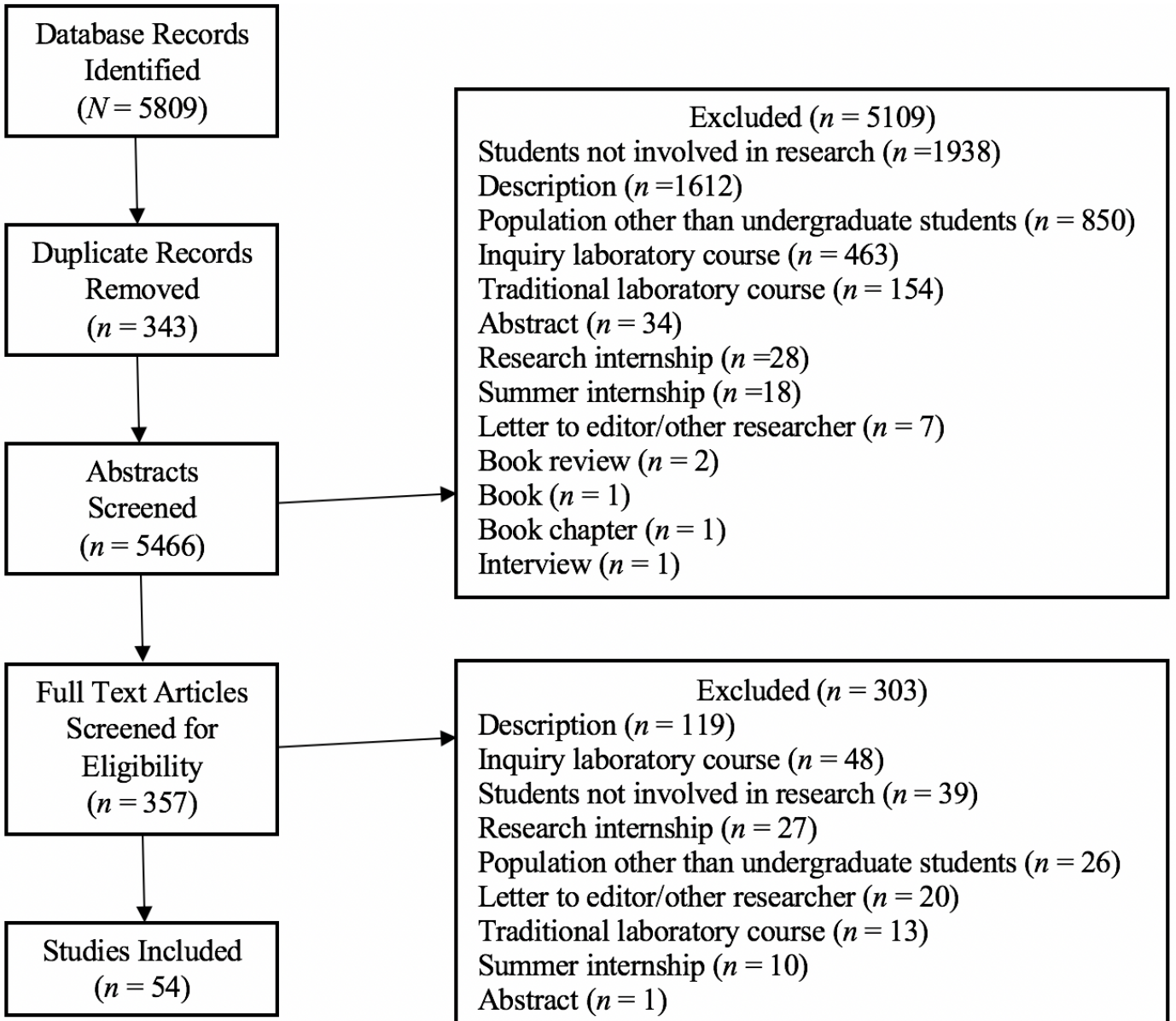


Figure 1: PRISMA Flow Diagram for the CURE Systematic Review

Dvorak, A. L., Davis, J., Bernard, G., Beveridge-Calvin, R., Monroe-Gulick, A., Thomas, P., & Forstot-Burke, C. (in press) Systematic review of course-based undergraduate research experiences: Implications for music therapy education. *Music Therapy Perspectives.*

Eric Search Strategy (Appendix)

Search Terms: Course Based
course based
SU.EXACT("Courses")
SU.EXACT("Science Experiments")
SU.EXACT("Educational Experiments")
SU.EXACT("Scientific Methodology")
SU.EXACT("Science Curriculum")
SU.EXACT("College Curriculum")
SU.EXACT("Scientific Research")
SU.EXACT("Science Process Skills")
SU.EXACT("Curriculum Implementation")
SU.EXACT("Scientific Principles")
classroom based
class based
SU.EXACT("STEM Education")
SU.EXACT("Learning Experience")
SU.EXACT("Curriculum Research")
course-embedded
SU.EXACT("Integrated Curriculum")
SU.EXACT("Educational Methods")
SU.EXACT("Problem Based Learning")
SU.EXACT("Student Educational Objectives")
curriculum based
SU.EXACT("Curriculum Design")
SU.EXACT("Classroom Research")
SU.EXACT.EXPLODE("Active Learning")
SU.EXACT.EXPLODE("Learner Engagement")
(Combined with OR)

Search Terms: Research
SU.EXACT("Research Opportunities")
SU.EXACT("Research Projects")
SU.EXACT.EXPLODE("Research Skills")
SU.EXACT.EXPLODE("Student Research")
SU.EXACT("Research")
research*
(Combined with OR)

Search Terms: Undergraduate
undergraduate research experience*
SU.EXACT("Undergraduate Study")
SU.EXACT.EXPLODE("Undergraduate Students")
undergraduate*
(combined with OR)
S1 and S2 and S3

Dvorak, A. L., Davis, J., Bernard, G., Beveridge-Calvin, R., Monroe-Gulick, A., Thomas, P., & Forstot-Burke, C. (in press) Systematic review of course-based undergraduate research experiences: Implications for music therapy education. *Music Therapy Perspectives.*

PRISMA Checklist

PRISMA 2009 Checklist

	#		Reported on page #
TITLE			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	1
ABSTRACT			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	2
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known.	3-6
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	6
METHODS			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.	7-8
Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	7-8
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	7
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	Online Appendix
Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	8
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	8
Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	8
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	8-9
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).	9
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency	8, Online

Questions?

Abbey Dvorak, Ph.D., MT-BC
Associate Professor of Music Education and Music Therapy
The University of Kansas
1530 Naismith Drive
Lawrence, KS 66045
Email: dvorak@ku.edu

Additional Resources:

- Campbell Collaboration recorded workshops, seminars & other training presentations https://campbellcollaboration.org/research-resources/training-courses.html
- The Cochrane Handbook for Systematic Reviews of Interventions https://training.cochrane.org/handbook
- PRISMA flow diagram http://prisma-statement.org/PRISMAStatement/FlowDiagram.aspx
- KU Libraries Systematic Review Service https://lib.ku.edu/services/research/systematic-reviews